June 14, 1932. J. N. MACRAE ET AL 1,862,690

OIL BURNING APPARATUS

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Fig. 1,

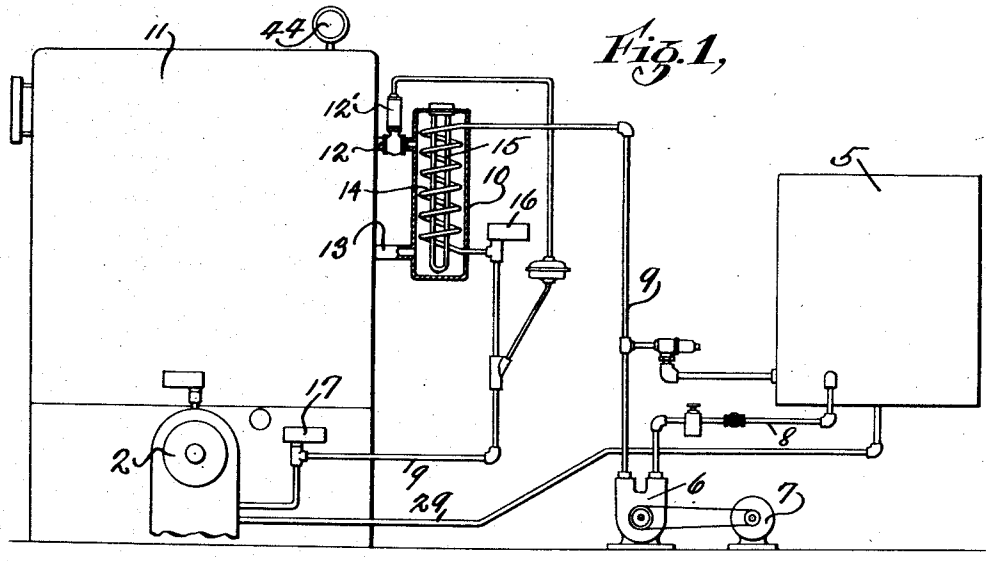
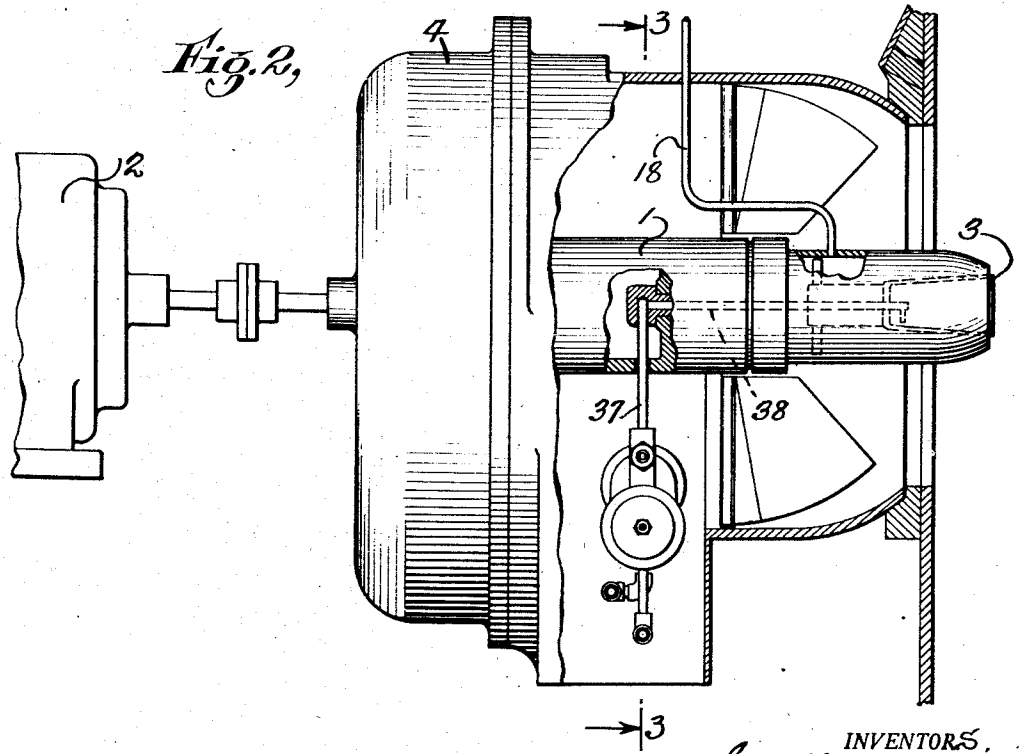


Fig. 2,



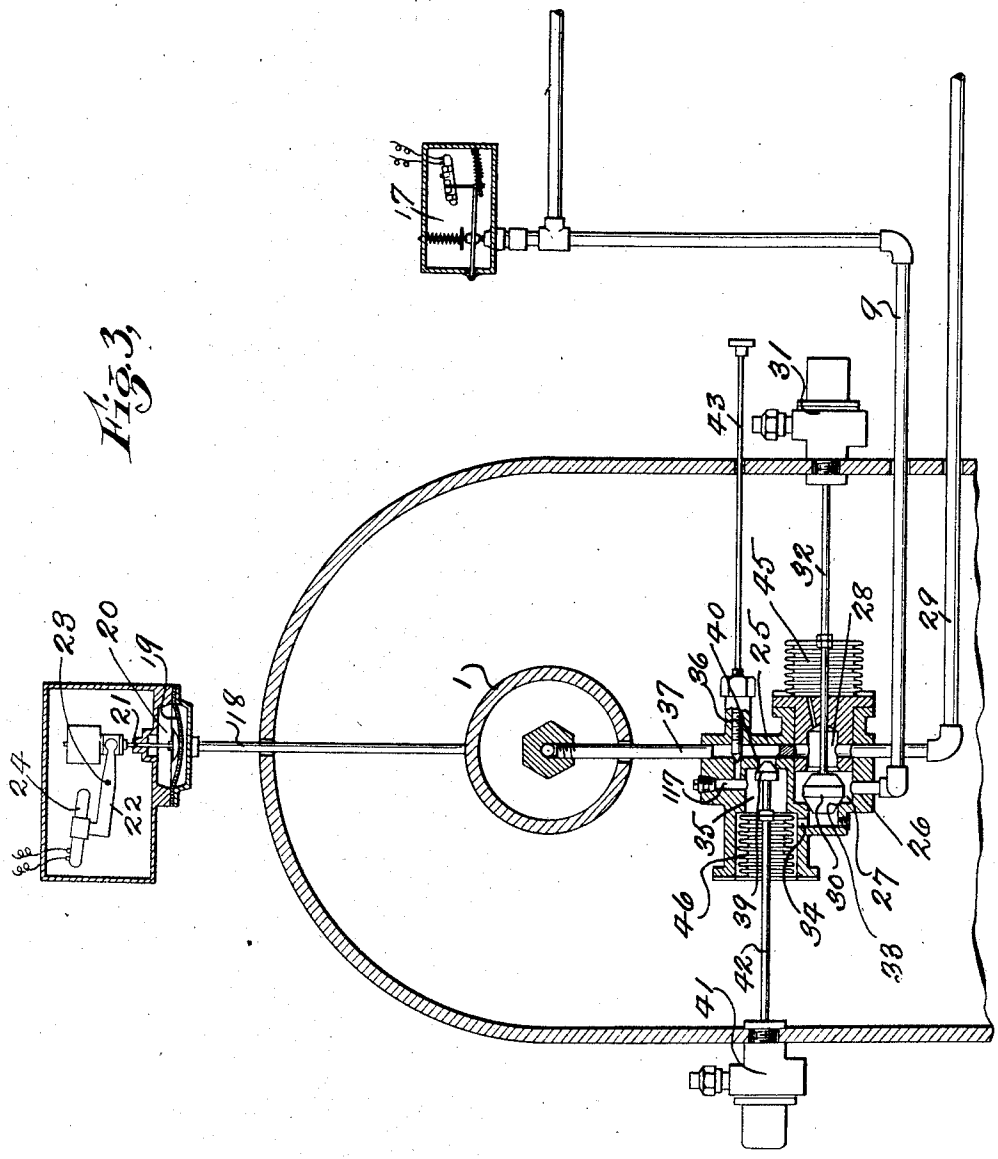
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OIL BURNING APPARATUS

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Fig. 3.



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OIL BURNING APPARATUS

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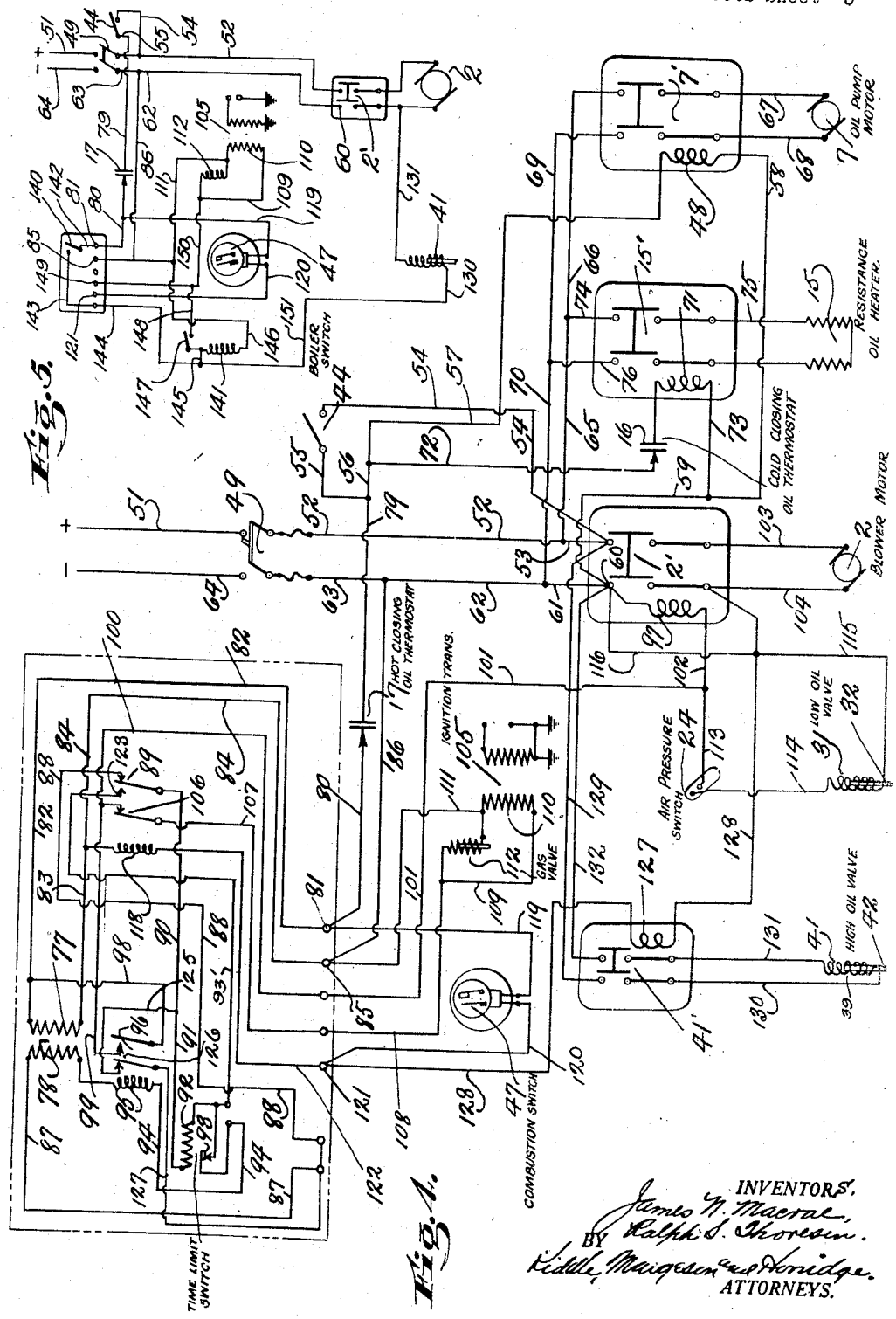


Fig. 3.

Fig. 4.

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1,862,690

UNITED STATES PATENT OFFICE

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OIL BURNING APPARATUS

Application filed August 28, 1929. Serial No. 388,884.

This invention relates to an improvement in oil burning apparatus, and has for one of its objects the provision of an apparatus of improved form so constructed, arranged and controlled as to particularly well adapt the apparatus for use with heavy oils.

Another object of our invention is the provision of an oil burning apparatus especially adapted for the burning of heavy oils wherein means are provided for preheating the oil before the same is supplied to the burner.

Other objects of our invention will appear hereinafter.

In the drawings:

Fig. 1 is a view in elevation of an installation of our invention;

Fig. 2 is a part sectional elevational view of the burner;

Fig. 3 is a section on the line 3—3 of Fig. 2;

Fig. 4 is a wiring diagram showing the various electric circuits for controlling the operation of the entire apparatus and with particular reference to the automatic control for the heating apparatus, whereby the oil is preheated before going to the burner; and

Fig. 5 is a wiring diagram of part of the electric circuits for controlling the operation of the apparatus with particular reference to a modified control of the valve which permits of the feeding of the maximum amount of oil to the burner.

Referring first of all to Figs. 1, 2 and 3, our improved apparatus comprises a burner 1 which has been illustrated as of the rotary cup type, that is to say, a burner in which oil is supplied to a cup rotating at high speed. The means for driving the cup constitute no part of the present invention and may be any of the well known forms of drive.

2 designates the blower motor, this motor as will be understood supplying air for supporting combustion and also driving the rotary cup which we have designated 3. 4 designates the blower housing.

5 designates an oil tank or reservoir from which the oil to be supplied to the cup 3 is pumped by a pump 6. 7 designates the motor for driving this pump. 8 designates an oil pipe or conduit leading from the tank 5 to the intake side of the pump, while 9 designates a pipe connected to the discharge side of the pump 6, this pipe passing through a tank 10 secured to the side of the boiler 11 which is to be heated by the burner. This tank 10 is connected to the boiler by pipes 12 and 13.

12′ designates a sylphon operated valve in the line from the boiler 11 whereby the pipe 12 is closed off to prevent the circulation of water or steam through the tank 10 when the oil in pipe 9 is sufficiently preheated.

The delivery pipe 9 where it passes through tank or box 10 is coiled as shown at 14. The tank or box 10 also contains an electric heating element designated 15 about which the pipe 9 is coiled and as hereinafter pointed out in more detail this heater is provided for the purpose of heating the oil passing through the coils 14 should the water in the boiler be at too low a temperature for heating up the oil to the desired degree.

16 designates a thermostatic switch provided for the purpose of closing and opening the circuit of the electric heater 15.

17 designates another thermostat for controlling the starting of the burner motor 2, this thermostat being in the line leading from the coils 14. The thermostats 16 and 17 are in series with each other.

The pipe shown at 18 leads from the casing of the burner 1 as shown in Fig. 2, as well as in Fig. 3, upwardly to a diaphragm 19 located in a chamber 20. At the upper side of this diaphragm is a push rod 21 operatively connected to a pivoted switch mount 22 pivoted at 23 and carrying a switch 24 of the mercury tube type. This switching mechanism, as will be hereinafter explained, is provided for the purpose of controlling the flow of oil to the burner initially. In this connection our construction provides for supplying a limited amount of oil and hence a lean mixture of oil and air to the burner initially until the same is operating satisfactorily and then afterwards to increase this amount of oil up to the capacity for which the apparatus may be set to give the proper proportion of oil and air for most efficient combustion. We find this mode of operation is more satisfactory than feeding the full

amount of oil initially, inasmuch as ignition is more certain and danger of explosion avoided.

The mechanical construction of the valve mechanism through which oil is passed to the burner is illustrated in Fig. 3. From an inspection of this figure it will be seen that this mechanism comprises a valve body 25.

The pipe 9 above referred to and which is connected to the discharge side of pump 6 lets into this valve body as shown at 26 and an inspection of the drawings will show that with the parts in the position shown in Fig. 3 oil will pass into valve chamber 27, chamber 28 and then out of the valve body again and by way of conduit 29 be returned to the tank 5.

30 designates a low oil valve which is located in the valve chamber 27. This valve is adapted to be actuated through a solenoid 31 the valve stem 32 being connected to or constituting the core of the solenoid. We have given this valve the designation "low oil" valve because of the fact that when only this valve is unseated the minimum amount of oil is supplied to the burner; perhaps fifteen gallons an hour, for example, as compared to forty-five gallons an hour which might be the capacity of the burner.

When the valve 30 is moved to the right, as viewed in Fig. 3, so as to move it off its seat 33, passage to chamber 28 is closed and oil can then pass to the burner from chamber 27 through port 34 to a second valve chamber 35 in the valve body 25 and from thence past adjustable by-pass valve 36 to pipe 37 which leads into the burner.

In this connection reference might be made to Fig. 2 from which it will be seen that the pipe 37 communicates with an oil pipe 38 leading to the oil cup 3. 39 designates another valve which for purposes of description we shall term the "high oil" valve, inasmuch as when this valve is moved off its seat 40 the capacity of the burner is satisfied, in other words, with the valve 39 unseated oil at the rate, for example, of forty-five gallons per hour is being supplied to the burner. The high oil valve 39 is adapted to be unseated by a solenoid 41, the valve stem 42 being connected to or constituting, as the case may be, the core of this solenoid.

The by-pass valve 36 above referred to is, as stated, adjustable and this adjustment may be effected by a stem 43 extending to the exterior of the burner housing.

44 designates a boiler control located at any convenient location in the boiler and adapted to be operated by the temperature of the water therein or if desired by the steam pressure in the boiler. This device it will be understood is provided for the purpose of starting the operation of the burner automatically when the steam pressure or the temperature of the water in the boiler has dropped below that for which the apparatus is set.

The low oil valve 30 and high oil valve 39 are normally seated by bellows or sylphon tubing 45 and 46, respectively.

In the operation of this apparatus and still without regard to the wiring diagram of Fig. 4, when the burner is shut down, that is to say, when the boiler control 44 is not calling for heat the blower motor 2 and the pump motor 7 are at rest. Assuming that the boiler 44 is calling for heat a circuit, as will be hereinafter pointed out, is closed to the pump motor 7 and the same will start running to draw oil from the tank 5 by way of pipe 8 and deliver it from the discharge side of the pump by way of pipe 9 through the coils 14 and past the thermostats 16 and 17 to the chamber 27 in which is located the low oil valve 30. If the oil is sufficiently warm a circuit will be closed to the blower motor 2 by control thermostat 17, and pressure will be built up in the burner which in time will raise the diaphragm 19 to close a circuit to the solenoid 31 for low oil valve 30.

On the other hand if the oil is too cool, thermostat 17 will not close, the blower motor will remain at rest and the oil will merely be circulated from the tank, chambers 27 and 28 of the valve body 25 and back to the tank. If the water or steam in coil box or tank 10 is not sufficient to heat this oil being circulated then heater thermostat 16 will close to close a circuit to electric heater 15. When the oil has heated sufficiently to satisfy the setting of the apparatus the control thermostat 17 will function to close a circuit to the fan or blower motor 2. The operation of this motor will supply air to the burner 1 and also build up a pressure in the burner which is transmitted through pipe 18 to the underside of the diaphragm 19. When sufficient pressure has been built up this diaphragm will raise, rocking the switch 24 to closed position to close a circuit to the low oil valve solenoid 31. Heated oil will then pass from the pipe 9 into the chamber 27 and from thence to port 34 to high oil valve chamber 35, past by-pass 36, pipe 37 to the burner cup 3.

It will be understood that at this time due to the solenoid 31 having been energized the low oil valve 30 has moved to the right as viewed in Fig. 3 so that communication is shut off between the chambers 27 and 28 which will prevent circulating of the oil from the tank through the valve body 25 and back to the tank again in a closed circuit as was the case when the apparatus started off. When the burner has operated for a sufficient length of time a switch shown at 47 and which is controlled by combustion will close, to close a circuit to the winding of the solenoid 41, exciting the same and the high oil

valve 39 will be moved off its seat so that oil can then pass this valve to the pipe 37 at the capacity of the burner.

It will be seen, therefore, that our apparatus provides for the preheating of the oil before the same is supplied to the burner, this preheating being effected by an electric heater and/or water or steam, the supplying of the oil to the burner being automatically controlled so that until the oil is sufficiently preheated the same is not allowed to pass to the burner at all. It will be seen also that means are provided for circulating the oil in order to preheat the same before the blower motor is started in operation. It will be appreciated also that by delaying the supplying of oil to the burner until the blower motor has operated, the cup 3 is permitted to come up to speed before any oil is supplied thereto.

It will be seen also that the changeover from minimum oil rate to maximum oil rate is controlled by combustion conditions. This is also of material advantage in that it insures that all the parts of the apparatus are at their proper operating point before the maximum supplying of oil is instituted.

Referring now to the diagram of Fig. 4, we will trace the various circuits which are made and broken during an operation of the burner: Assuming that the boiler control 44 is calling for heat, the same will of course be closed and a circuit for the winding 48 of the pump motor switch 7′ is closed, it being understood of course that the main switch 49 has previously been closed. This circuit may be traced from one side of the line by way of conductor 51, switch 49, conductors 52, 53, 54, boiler control 44, conductors 55, 56, 57, winding 48, conductors 58, 59, terminal 60, conductors 61, 62, 63, switch 49, conductor 64, to the other side of the line.

The closing of the switch 7′ closes a circuit to the oil pump motor 7 as follows: Conductor 51, switch 49, conductors 52, 65, 66, switch 7′, conductor 67, motor 7, conductor 68, switch 7′, conductors 69, 70, 62, 63, switch 49, conductor 64, to the other side of the line.

If the water or steam in the tank 10 at this time is not at a sufficiently high temperature to warm or preheat the oil to the desired degree the pump 7 as above explained merely circulates the oil in a closed circuit from the tank 5 through the pipe 9, coils 14, valve chambers 27, 28 and pipe 29 back to the tank. Under these conditions heater thermostat 16 is closed and a circuit to the winding 71 of the heater switch 15′ may be traced as follows: From one side of the line by way of conductor 51, switch 49, conductors 52, 53, 54, boiler control 44, conductors 55, 56, 72, thermostat 16, winding 71, conductors 73, 59, terminal 60, conductors 61, 62, 63, switch 49, conductor 64, to the other side of the line.

The closing of switch 15′ closes a circuit to the heater 15 as follows: From one side of the line by way of conductor 51, switch 49, conductors 52, 65, 74, switch 15′, conductor 75, coil 15, to the other side of the switch 15′, conductors 76, 70, 62, 63, switch 49, conductor 64, to the other side of the line.

When the oil being circulated has been heated sufficiently hot closing oil control thermostat 17 will close whereupon a circuit will be closed to the primary 77 of transformer 78 as follows: From one side of the line by way of conductor 51, switch 49, conductors 52, 53, 54, boiler control 44, conductors 55, 79, thermostat 17, conductor 80, terminal 81, conductor 82, primary 77, conductors 83, 84, terminal 85, conductors 86, 63, switch 49, conductor 64, to the other side of the line.

The circuit of the secondary of the transformer 78 may be traced from one side of the secondary, conductors 87, 88, switch 89 which at this time is closed, conductors 90, 91, heater coil 92 for switch 93, through said switch, conductor 94, relay coil 95, to the other side of the winding. The energizing of the relay winding 95 will close the switch 96 and a circuit is now closed for the holding coil 97 of the motor switch 2′ for the blower motor 2 so as to close a circuit to this motor. The circuit of this coil 97 may be traced as follows: From one side of the line by way of conductor 51, switch 49, conductors 52, 53, 54, boiler control 44, conductors 55, 79, control thermostat 17, conductor 80, terminal 81, conductors 82, 98, switch 96, conductors 99, 100, 101, 102, winding 97, terminal 60, conductors 61, 62, 63, switch 49, conductor 64, to the other side of the line.

The switch 2′ now closes, to close a circuit to the blower motor 2 from one side of the line by way of conductor 51, switch 49, conductors 52, 53, switch 2′, conductor 103, motor 2, conductor 104, to the other side of the switch 2′, conductors 61, 62, 63, switch 49, conductor 64, to the other side of the line.

At this time also a circuit is closed to the primary of the ignition transformer 105 as follows:

From one side of the line, conductor 51, switch 49, conductors 52, 53, 54, boiler control 44, conductors 55, 79, control thermostat 17, conductor 80, terminal 81, conductors 82, 98, switch 96, conductor 99, switch 106, conductors 107, 108, 109, primary winding 110, conductors 111, 86, 63, switch 49, conductor 64, to the other side of the line. A circuit is also closed at this time to the winding 112 of the gas valve constituting part of the ignition system, this winding as will be observed from the diagram being shunted across the primary 110 of the ignition transformer 105.

We now have ignition on, oil preheated and blower motor in operation, but no oil being fed to the burner. As soon, however, as the

blower motor 2 builds up sufficient pressure in the air line 18 leading from the burner housing to raise the diaphragm 19 of Fig. 3 the mercury tube switch 24 will be tipped to closed position, to close a circuit to the winding of solenoid 31 of the low oil valve 30 as follows: From one side of the line, conductor 51, switch 49, conductors 52, 53, 54, boiler control 44, conductors 55, 79, control thermostat 17, conductor 80, terminal 81, conductors 82, 98, switch 96, conductors 99, 100, 101, 113, switch 24, conductor 114, winding of solenoid 31, conductors 115, 116, 61, 62, 63, switch 49, conductor 64, to the other side of the line.

The low oil valve 30 will now be moved to the right as viewed in Fig. 3, so that preheated oil is supplied to the burner, from the tank 5, pipe 8, pump 6, pipe 9, heater tank 10, valve chamber 27, port 34, chamber 35, port 117 past valve 36 to pipe 37, and by way of pipe 38 to the burner cup 3.

It will be appreciated that the supplying of oil to the burner initially does not take place until the oil has been preheated to the temperature to which the apparatus is set for, because of the fact that valve 30 is not unseated until the mercury tube switch 24 is closed and this switch is closed by building up pressure in the system with the blower motor, the circuit of which is not closed, until the control thermostat 17 has been closed by the heat of the oil. This construction, therefore, insures that before any oil passes to the burner it must be heated to a predetermined temperature.

47 designates a switch adapted to be closed when combustion is initiated, and we will assume that combustion has taken place, the transformer 105 having been supplied with current as above described and the gas valve 112 having been opened as also described.

When the switch 47 has closed, due to the fact that combustion has taken place, a circuit is closed for a relay 118 as follows: From one side of the line, conductor 51, switch 49, conductors 52, 53, 54, boiler control 44, conductors 55, 79, control thermostat 17, conductor 80, terminal 81, conductor 119, switch 47, conductor 120, terminal 121, conductor 122, winding of the relay 118, conductor 84, terminal 85, conductors 86, 63, switch 49, conductor 64, to the other side of the line. The energizing of the winding of the relay 118 opens the switch 106 thereby opening the circuit of the primary of the ignition transformer and closes the switch 89 on the contact 123.

The closing of switch 89 on the contact 123 shorts out the heating coil 92. On ignition failure, however, heating coil 92 continues to receive current finally to open switch 93 which opens relay 95, thereby opening the circuit of the winding 97 of the main motor switch 2′ and the main motor will stop until parts are reset manually.

It will be remembered that the circuit previously traced for the relay 95, and which relay closes a switch 96 which is in the circuit for the holding coil 97 of the main motor switch 2′, passed through the switch 89 which has now been opened by energizing of the winding of the relay 118. It is necessary that the relay 95 remain energized in order that the circuit to the blower motor 2 remains closed. Consequently we have provided an additional circuit acting as a holding circuit for the relay 95. This circuit may be traced as follows: From one side of the secondary of the transformer 78, winding of relay 95, conductor 94, switch 93, conductor 93′, contact 123, switch 89, conductors 90, 125, switch 126, conductors 127, 87, to the other side of the transformer.

The closure of the switch 47 closes a circuit to the winding 127 of the switch 41′ for the high oil valve 41 which may be traced as follows: From one side of the line, conductor 51, switch 49, conductors 53, 54, boiler control 44, conductors 55, 79, control thermostat 17, conductor 80, terminal 81, conductor 119, switch 47, conductor 120, terminal 121, conductor 128, winding 127, conductors 128, 116, 61, 62, 63, switch 49, conductor 64, to the other side of the line. The exciting of the winding 127 closes the switch 41′ and a circuit is now closed for the winding of the high oil valve solenoid 41. This circuit may be traced from one side of the line, conductor 51, switch 49, conductors 52, 53, 129, one side of switch 41′, conductor 130, winding of solenoid 41, conductors 131, 132, terminal 60, conductors 61, 62, 63, switch 49, conductor 64, to the other side of the line.

The energizing of the winding 41 effects a movement of the high oil valve 39 to the left, as viewed in Fig. 3, and the oil at the capacity of the apparatus is now supplied to the burner, passing from pipe 9 to valve chamber 27, by way of port 34, to valve chamber 35, and from thence past the valve 39 which is now unseated to pipes 37 and 38 to the burner cup.

After the temperature in boiler 11 has been raised sufficiently, boiler control 44 will open, and all parts will be restored to their initial position.

It will be seen from the foregoing that we have provided an oil burning apparatus in which the oil is preheated before being supplied to the burner, means operating automatically being provided whereby unless the oil is preheated to a predetermined temperature the oil will merely circulate in a closed circuit until its temperature is raised.

It will be seen also from all the foregoing that we have provided a control for the preheating as well as for the supplying of oil

to the burner, whereby initially only the minimum amount of oil is supplied, the capacity of the burner being satisfied only after the burner has been operating a predetermined length of time.

It will be appreciated also that when the apparatus is shut down all parts are restored to initial position so as to be ready for operation the next time the boiler control 44 calls for heat.

In the modified diagram of Fig. 5 we have modified the circuits somewhat for the control of the high oil valve coil 41. It will be understood that this diagram of Fig. 5 does not attempt to show all of the circuits of the control but only those in connection with the modification, the remaining circuits being as shown in Fig. 4. For the sake of clarity we might say that the change in Fig. 5 from the operation of Fig. 4 is directed principally to the operation of the high oil valve 40 and control of the ignition.

It will be recalled and it will be seen from an inspection of Fig. 4 that after the switch 47 closes, this switch closing due to combustion having been initiated, a circuit was closed to the relay 118, the closing of this circuit opening the switch 106 which would open the circuit of ignition transformer 105. In this modified circuit, the ignition circuit is held closed for a predetermined length of time after switch 47 has closed.

Referring to Fig. 5, the closing of switch 47 with a consequent energizing of relay 118 closes a switch 140. This closing of the switch 140 closes a circuit to a delayed action relay 141. This circuit may be traced as follows: From one side of the line, conductor 51, switch 49, conductors 52, 54, boiler control 44, conductors 55, 79, control thermostat 17, conductor 80, terminal 81, conductor 142, switch 140, conductors 143, 144, 145, delayed action relay 141, conductor 146, terminal 85, conductors 86, 63, switch 49, conductor 64, to the other side of the line.

The relay 141 is a delayed action relay, however, and does not operate to open switch 147 for a period of approximately thirty seconds.

As long as the switch 147 is held closed, due to relay 141 not having actuated, a parallel circuit is maintained to the ignition as follows: From one side of the line, conductor 51, switch 49, conductors 52, 54, boiler control 44, conductors 55, 79, control thermostat 17, conductor 80, terminal 81, conductor 142, switch 140, conductors 143, 144, 145, switch 147, conductor 148, terminal 149, conductors 150, 109, transformer winding 110, conductor 111, terminal 85, conductors 86, 63, switch 49, conductor 64, to the other side of the line. Of course this circuit is only maintained as long as the relay 141 is delayed in opening the switch 147.

The closing of the switch 140 above referred to will close a circuit to the winding 41 of the high oil valve, it being understood that this circuit is closed at the time current is supplied to the winding of the delayed action relay 141. The circuit to this winding 41 may be traced from one side of the line by way of conductor 51, switch 49, conductors 52, 54, boiler control 44, conductors 55, 79, control thermostat 17, conductor 80, terminal 81, conductor 142, switch 140, conductors 143, 144, 151, winding 41, conductor 131, switch 2′, terminal 60, conductors 62, 63, switch 49, conductor 64, to the other side of the line.

This arrangement of circuits provides, therefore, a control in which instead of the ignition being opened upon the exciting of the relay 118, as in the diagram of Fig. 4, the exciting of this relay closes a switch 140 and this supplies current to the delayed action relay 141 to which is connected a switch 147 which is adapted to maintain closed the ignition circuit until after the delayed action relay has functioned.

It will be seen also that the closure of the switch 140 closes a circuit to the high oil valve as just traced and consequently the high oil valve is opened before the ignition is opened.

It is to be understood that changes may be made in the details of construction above described within the purview of our invention.

What we claim is:—

1. Oil burning apparatus comprising in combination a burner, a blower therefor, an electric blower motor, an electric switch for controlling the circuit of the blower motor, means for supplying oil to the burner, means for preheating the oil, a transformer, a thermostatic switch in the circuit of said transformer operated by the oil temperature, a relay controlled by said transformer for controlling said electric switch, and a valve for preventing a flow of oil to the burner prior to the closure of said thermostatic switch, operation of the blower motor being essential to an opening of said valve.

2. Oil burning apparatus comprising in combination a burner, a blower, an electric blower motor, an oil supply, means for conducting oil from said supply to the said burner, means for preheating the oil, a switch for controlling the circuit of said motor, a transformer thermostatic switch in the circuit of said transformer controlled by the oil temperature, a relay controlled by said transformer for controlling said switch, an oil valve for preventing passage of the oil to the burner when below a predetermined temperature, and switching mechanism for said valve controlled by the pressure built up by said blower.

3. Oil burning apparatus comprising in combination a burner, a blower, an electric blower motor, an oil supply, means for con-

ducting oil from said supply to the said burner, means for preheating the oil, a switch for controlling the circuit of said motor, a transformer, a thermostatic switch in the circuit of said transformer controlled by the oil temperature, a relay controlled by said transformer for controlling said switch, an oil valve for preventing a flow of oil to the burner when below a predetermined temperature, and electric switching mechanism for said valve controlled by the pressure built up by said blower.

4. In oil burning apparatus, the combination of a burner, means for supplying oil thereto, means for preheating the oil, a valve controlling the admission of oil to the burner, means controlled by the temperature of the oil for operating said valve to control the admission of oil for ignition, a second cooperating valve, and means for opening said second valve only after the operation of the first-mentioned valve for controlling the admission of maximum oil to the burner after the operation of the first-mentioned valve.

5. In oil burning apparatus, the combination of a burner, means for supplying oil thereto, means for preheating the oil, a valve, means controlled by the temperature of the oil for operating said valve to control the admission of oil to the burner for ignition, and a second cooperating valve controlled by ignition of the fuel and operating to admit the maximum amount of oil to the burner.

6. In oil burning apparatus, the combination of a burner, a pump for supplying oil to the burner, a blower, a blower motor, an electrically actuated switch for said motor, means for heating the oil, a temperature controlled switch in the oil line for controlling said electrically actuated switch, a switch controlled by the pressure built up by said blower, an electrically actuated valve controlled by said switch for controlling the admission of oil to the burner, and a second valve controlled by combustion conditions for controlling the admission of an additional amount of oil to the burner.

7. In oil burning apparatus, the combination of a burner, a pump for supplying oil thereto, a temperature controlled heater for preheating the oil passing to the said burner, a blower, a blower motor, a temperature controlled switch for closing the circuit of the blower motor, an electrically operated valve for controlling the initial admission of oil to the burner, blower pressure responsive means for energizing said valve, and a second valve controlled by the ignition of the oil initially admitted to the burner for increasing the amount of oil supplied to the burner to the maximum.

8. Oil burning apparatus comprising in combination a burner, a blower therefor, an electric blower motor, means for supplying oil to the burner, means for preheating said oil, a transformer, a thermostatic switch in the circuit of said transformer and operated by the oil temperature, a relay controlled by said transformer, and a switch controlled by said relay for controlling the circuit of said blower motor.

This specification signed this 26th day of August, 1929.

JAMES N. MACRAE.

This specification signed this 26th day of August, 1929.

RALPH S. THORESEN.